MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

EEL 3146 – ELECTRIC POWER UTILIZATION AND INSTALLATION

(LE)

10 MARCH 2016
9:00 AM – 11:00 AM
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of 8 pages including cover page with 5 Questions only.
2. Answer ALL questions. All questions carry equal marks and the distributions of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.

Question 1

a) Explain the four roles of Energy Commission in Malaysia.

[5 marks]

b) Explain the importance of Code of Practice (COP) 05 below in MS1979: 2007 Electrical Installations of Buildings.

> *All metal enclosures of electrical equipment shall be earthed (connected to a protective conductor). In addition, water and gas pipes, structural metal parts of the building and the ducting of the air conditioning system shall also be connected to the main equipotential bonding.*

[6 marks]

c) Explain the need for various RCCB sensitivity rating in domestic distribution system. Explain why water heater circuit is separately protected with 10mA RCCB.

[5 marks]

d) Sketch a single line diagram for an electrical installation in a domestic system. Given following loads:

- 2 × Switch Socket Outlets, MCB 20A, 2.5mm^2 PVC insulated cable, in PVC Conduit
- 6 × Downlights , MCB 10A, 1.5mm^2 PVC insulated cable, in PVC Conduit
- 1 × Water Heater, MCB 20A, 2.5mm^2 PVC insulated cable, in PVC Conduit
- 1 × 1hp Air Conditioner, MCB 20A, 2.5mm^2 PVC insulated cable, in PVC Conduit

[4 marks]

Question 2

a) The scheduled speed of a LRT train (Figure Q2a) including a station stop of 30 sec is 45 km/hr. The acceleration is 1.7 km/hr/sec; determine the value of retardation.

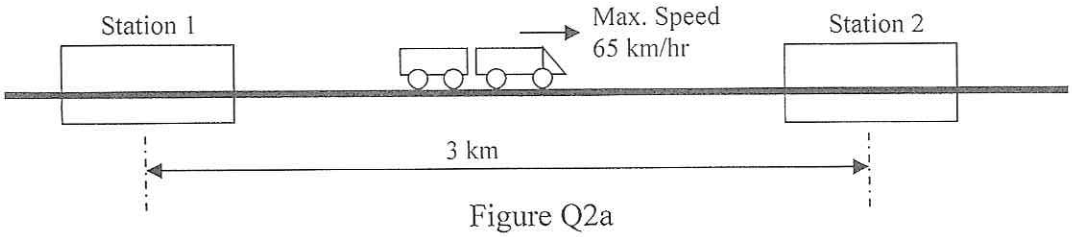

Figure Q2a

[11 Marks]

b) Classify regions (1 to 5) in Figure Q2b. Discuss the speed-time curve of a train taking notes on its usage.

[9 Marks]

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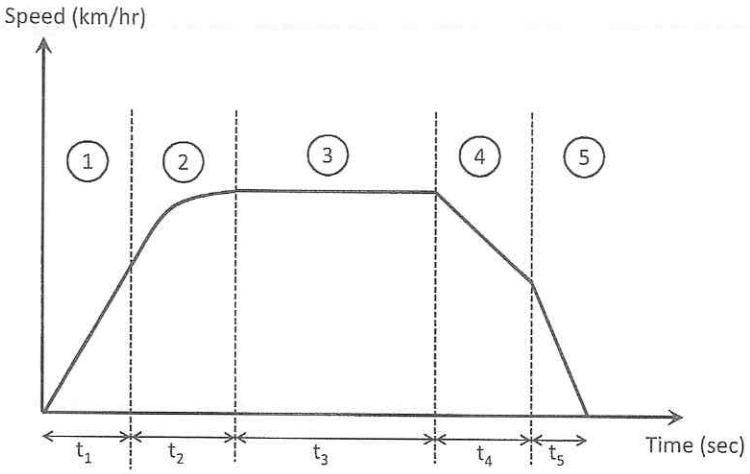

Figure Q2b

Question 3

A circuit supplying a fixed equipment as shown in Figure Q3a is protected with a type C Miniature Circuit Breaker (MCB). The installation is done with 4 mm^2 single core PVC non-sheathed cables enclosed in PVC conduit. Calculate the suitable size for the circuit protective conductor. (Use Figure Q3b, Table 1). Cross check your answer with the adiabatic equation, given k =115.

Given, the fault earth loop impedance of the supply is 0.5Ω and expected disconnection time is 5 s. The time/current characteristic of MCB is shown in Figure Q3b.

[20 Marks]

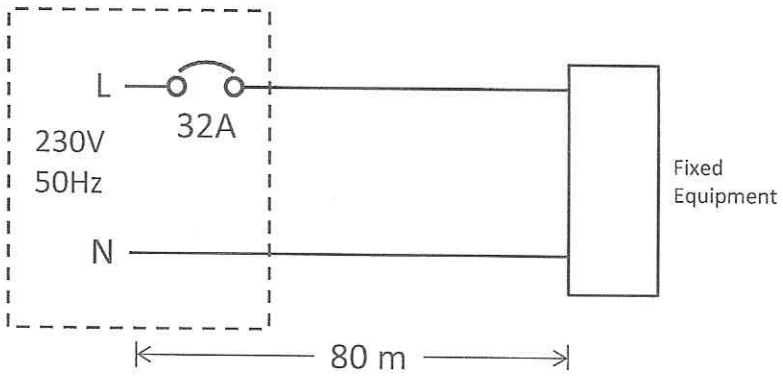

Figure Q3a

Continued...

Table 1 - Resistance per meter of copper conductors at 20°C for calculation of R1 + R2	
Conductor cross-sectional area (mm²)	*Resistance per meter run (m ohms / m)*
1.0	18.1
1.5	12.10
2.5	7.41
4.0	4.61
6.0	3.08
10.0	1.83
16.0	1.15
25.0	0.727
Note that to allow for the increase in resistance with increased temperature under fault conditions the values of {Table 1} must be multiplied by 1.2 for p.v.c. insulated cables	

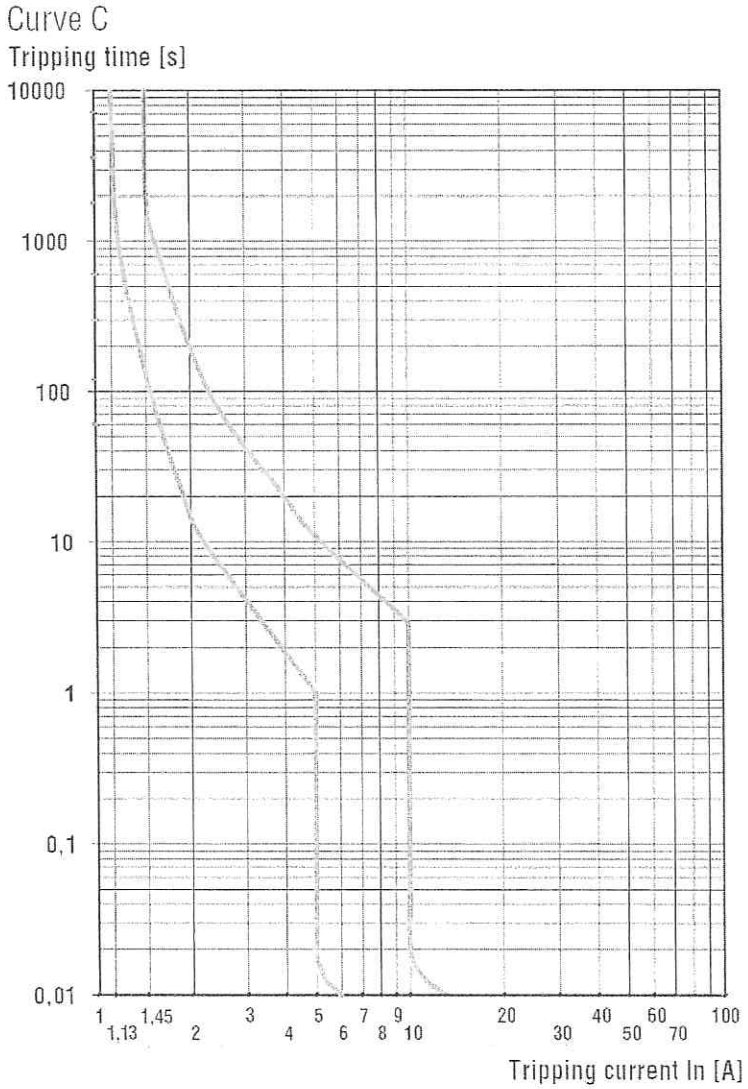

Figure Q3b: Time/current characteristics of Type C MCB

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Question 4

Both plan and front views of a class room are shown in Figures Q4a and Q4b respectively. Details of the lamp for this class room are 100-240V, 1350 lm and 23W.

a) Determine the minimum illuminance for this class room. Refer to table in Appendix A. [3 Marks]

b) Determine the number of lamps required to obtain the minimum illuminance. Assuming the maintenance factor is 0.85 and that coefficient of utilization is 0.7. [7 Marks]

c) If some other lamp with luminous intensity of 3500 cd is selected for the class room. Calculate the minimum height, Y (from ceiling to workspace as shown in Figure Q4b) required to obtain 300 lux. [5 Marks]

d) What will be the lux at point X in Figure Q4b if the same lamp (as in (c)) is used? The beam angle for the lamp is 60 degree. [5 Marks]

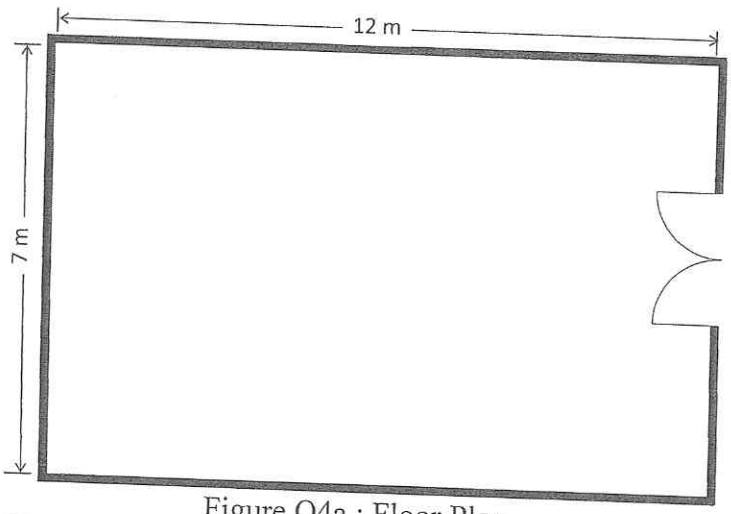

Figure Q4a : Floor Plan

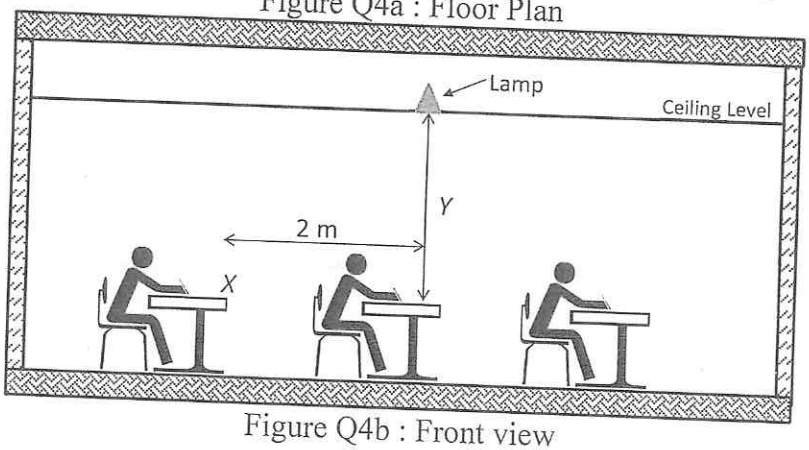

Figure Q4b : Front view

Continued...

Question 5

a) State two differences between direct and indirect resistance heating. [8 Marks]

b) Discuss two methods used to control the temperature in a resistance heater. [4 Marks]

c) Estimate the efficiency of a high frequency induction furnace which takes 10 minutes to melt 1.8 kg of an aluminium material if the input to the furnace is 5 kW and initial temperature 15°C. Given the following details.

Specific heat of aluminium = 880 J $kg^{-1}°C^{-1}$.
Me1ting point of steel = 660 ° C.
Latent heat of fusion of steel = 32 k J / kg

(Given 1J = 2.78 x 10^{-7} kWhr)

[8 Marks]

Continued...

Appendix A: MS 1525:2014

Table 10. Recommended average illuminance levels

Task and Applications	Illuminance (Lux)
a) Lighting for infrequently used area:	
- Minimum service illuminance	20
- Interior walkway and car-park	100
- Hotel bedroom	100
- Lift interior	100
- Corridor, passageways, stairs	100
- Escalator, travellator	150
- Entrance and exit	100
- Staff changing room, locker and cleaner room, cloak room, lavatories, stores.	100
- Entrance hall, lobbies, waiting room	100
- Inquiry desk	300
- Gate house	200
b) Lighting for working interiors	
- Infrequent reading and writing	200
- General offices, shops and stores, reading and writing	300 - 400
- Drawing office	300 - 400
- Restroom	150
- Restaurant, canteen, cafeteria	200
- Kitchen	150 - 300
- Lounge	150
- Bathroom	150
- Toilet	100
- Bedroom	100
- Class room, library	300 - 500
- Shop/supermarket/department store	200 - 750
- Museum and gallery	300
c) Localised lighting for exacting task	
- Proof reading	500
- Exacting drawing	1000
- Detailed and precise work	2000

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Examination Formula Sheet EEL3146

Lighting and Illumination

Inverse-square law

$$E = \frac{I}{d^2}, \quad E_x = \frac{I\cos^3\theta}{d^2}$$

Electric Traction

Trapezoidal Approximation

$$D = \frac{\left[2TV_m - V_m^2\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)\right]}{7200}$$

Quadrilateral Approximation

$$D = \frac{\left[(V_1 + V_2)T - V_1V_2\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)\right]}{7200}$$

$$V_2 = \frac{V_1 - \beta_c\left(T - \frac{V_1}{\alpha}\right)}{1 - \frac{\beta_c}{\beta}}$$

Net tractive effort for propulsion of train

$$F_t = 277.8M_e\alpha + Mr \pm 98MG$$

Total specific energy output

$$E_T = \frac{0.010726V_m^2}{D}\left(\frac{M_e}{M}\right) + 0.2778r\frac{D'}{D} \pm 27.25G\frac{D'}{D} \quad Whr/Ton\,km$$

Electric Heating

Heat transferred by radiation

$$Q = e\sigma A(\Delta T)^4$$

Where Q is the heat transferred by radiation, E is the emissivity of the system, σ is the constant of Stephan-Boltzmann (5.6697 x 10^-8 W/m^2.K^4), A is the area involved in the heat transfer by radiation, and $(\Delta T)^4$ is the difference of temperature between two systems to the fourth or higher power.

Earthing and Protection

Adiabatic equation

$$S = \frac{\sqrt{I_a^2 t}}{k}$$

End of paper